PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

GEOTECHNICAL AND GEOCHEMICAL CHARACTERIZATION OF CLEAN COAL TECHNOLOGY BY-PRODUCTS

PRIMARY PROJECT PARTNER

Universal Fuel Development Associates
Grand Forks, ND

MAIN SITE

Universal Fuel Development Associates
Grand Forks, ND
University of North Dakota Energy and Environmental Research Center
Grand Forks, ND

TOTAL ESTIMATED COST

$374,100

COST SHARING

DOE	$374,100
Non-DOE	—

Description

Emerging coal conversion technologies being developed through the DOE's Clean Coal Technology program rely on innovative combustion conditions and gas clean-up systems to increase efficiency and reduce air pollution. These changes in combustion conditions result in by-products which are significantly different from conventional coal combustion by-products like fly ash and flue gas desulfurization (FGD) sludge. As pilot-scale facilities employing these new technologies come into production the by-products need to be characterized so that options for utilization or disposal can be evaluated.

Universal Fuel Associates has performed detailed geochemical and geotechnical evaluations of 34 by-products from 16 different Clean Coal Technology processes. Processes examined include atmospheric and pressurized fluidized bed combustion (AFBC and PFBC); coal gasification, reburner processes for NO_x reduction, and in-furnace or in-duct sorbent injection processes. The information from these tests will help energy planners, engineers, and regulators make informed decisions about how best to manage by-products from emerging coal processes.

Most Clean Coal byproducts were found to fail the American Society of Testing and Materials (ASTM) criteria for use in cement or concrete. Because the fluidized bed and sorbent injection technologies investigated use sorbents to trap pollutants such as SO_x in the solid phase, their by-products typically contain more sulfate than the specifications allow. The sulfate contents of the by-products ranges from over 23% for PFBC fly ash to near zero in coal reburning bottom ash.

Other processes may result in an unacceptable grain size distribution or excessive unburned carbon for use in cement products. Many processes produce a granular bottom ash, and carbon contents as high as 13.5% were reported for one FBC fly ash.

Many of the Clean Coal by-products also contain lime. The reactivity of the lime can complicate handling these materials. Water added to the by-products to condition them for compaction can generate heat as it combines with the lime. In some cases boiling temperatures can be rapidly generated and substantial amounts of steam can be given off. Reactive ashes can also harden after exposure to water, in some cases setting up like a low strength concrete. In most cases these pozzolanic reactions are slow, requiring a week or more to develop significant strength and do not pose problems if equipment is regularly cleaned. In some cases, however, the by-products may set enough during transport to make it difficult to remove them from the truck, rail car, or barge in which they were loaded.

Geotechnical and Geochemical Characterization of Clean Coal Technology By-Products

Materials which do not meet ASTM specification may find uses in less demanding applications such as for soil conditioning, as a mineral filler or aggregate, or as a lime replacement. Alternate applications may also be developed to make use of some of the unique characteristics of these new materials.

Description

Other material properties such as abrasiveness, corrosivity, bulk density, optimum moisture, and permeability were also evaluated to assist in the design of by-product management facilities. Equipment such as silos, conveyors, and sluices must be designed with these by-product characteristics in mind. Disposal facility design also need to reflect the characteristics of the by-product materials.

Goal

To ensure the most cost-efficient delivery of electrical power, the DOE is conducting research and development to improve coal combustion by-product (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current FGD by-product utilization rate, a 10% increase in the national rate of overall CCB utilization, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- By-product uses can be developed as technology is commercialized.
- Gives energy and by-product management communities information on emerging technologies.
- Provides consistent, quality data on by-product properties.

CONTACT POINTS

Edwin S. Olson
Universal Fuel Development Associates
Grand Forks, ND
(701) 777-5155
(707) 777-5181 fax
eolson@eerc.und.nodak.edu

William W. Aljoe
U.S. Department of Energy
National Energy Technology Laboratory
Pittsburgh, PA
(412) 386-6569
(412) 386-5917 fax
william.aljoe@netl.doe.gov

PROJECT PARTNERS

Universal Fuel Development Associates
Grand Forks, ND
(project management)

Advanced Technology Systems, Inc.
Monroeville, PA
(sample collection)

University of North Dakota Energy and Environmental Research Center
Grand Forks, ND
(main subcontractor)